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ABSTRACT

This paper contains a description of the status of a project on student information processing responses that mediate teaching effects in classroom settings. The central activity of the project is the construction of a conceptual model that relates classroom task structures to student information processing and to subject-matter achievement. The data base for this model is derived from several domains, especially cognitive psychology, prose learning research, and naturalistic studies of teaching. The model is being used to analyze and integrate existing research and to formulate specific hypotheses about what is learned, how much is learned, and who learns in classroom environments. (Author)

STUDENT MEDIATING RESPONSES IN TEACHING EFFECTIVENESS: AN INTERIM REPORT

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AN INTERIM REPORT

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The project on student mediating responses was initiated in response to a need within the teaching effectiveness field for interpretive models that incorporate features of the classroom setting. In these brief remarks I will attempt to describe the nature of the project, summarize some of the core elements of the student mediating response model that is emerging from the analytical work, and discuss some of the preliminary implications of the model for current topics in teaching effectiveness research. Since part of the analysis is still being conducted, the present formulations are necessarily tentative.

Nature of the Project

The project is organized around three broad areas of concern: (a) student information-processing responses; (b) demand characteristics of the classroom environment; and (c) effective teaching. The central activity of the project is the construction of a conceptual model that integrates these three areas in terms of the student processes that mediate teaching effects in classroom settings. This conceptual model is being designed primarily as a descriptive

framework for understanding how classroom effects occur. This descriptive framework, in turn, is being used to formulate questions for further research on effective teaching.

The model-building activities of the project are grounded in a comprehensive review of research and theory on student variables in instruction. Information is being selected primarily from six domains: (1) prose learning research; (2) instructional psychology; (3) student behavior research; (4) student perception research; (5) classroom process studies; and (6) reading. During the course of the project, the review work has tended to focus on naturalistic studies of classrooms and on experimental research on cognition, since these two areas have provided the most fruitful sources of relevant data and conceptualizations. The developmental literature has also been examined to account for student mediating processes at different age levels.

It is important to emphasize that the review phase of the work is necessarily selective, given the range of potentially relevant information. This selectivity is guided first by an overriding interest in accounting for teaching effects in classroom settings. The emphasis, therefore, is on the distinctive features of classroom systems and how they impinge upon student learning. Attention is also focused primarily on the academic outcomes of learning from classrooms. The classroom, in other words, is being viewed as an academic system,

although it is recognized that this is a somewhat restricted approach to classroom effects. Finally, cause-effect relationships in classrooms are being viewed as information resources which students can use to accomplish classroom tasks. This approach to causality differs, of course, from the more common reliance on reinforcement and/or practice effects to explain learning in classrooms.

Several problems are encountered in attempting to conceptualize student mediating responses in teaching effectiveness. First, very little information is available concerning student processes in classrooms. The bulk of the process research in classrooms has focused on teacher variables. Second, much of what we do know about students tends to be at best a gross indicator of mediating processes. Data about attention rates or "time on task" or about various aptitude or style variables measured by paper-and-pencil tests are of limited utility in specifying the information-processing responses that mediate classroom learning. Finally, much of the experimental research on mediating processes in learning and cognition is conducted in settings that differ substantially from classrooms. Research on prose learning, for example, deals with written materials in isolation from classroom contexts. The attempt to build a conceptual foundation for research on student processes in classroom settings has required, therefore, reasonably intense analytical effort and several blind leads have been unwittingly pursued.

Toward a Model of Student Mediating Responses

Student mediating responses unique to classroom settings are being identified by an analysis of the interaction of environmental demands and information-processing capabilities. The format for this model-building dimension of the project can be defined in terms of three components: (1) describing, on the basis of naturalistic data, the demand structure of classrooms; (2) specifying, using a combination of rational and empirical task analyses, some of the student information-processing capabilities necessary to meet these demands of the classroom environment; and (3) delineating some of the ways in which meeting classroom demands influences what students learn. In what follows I will attempt to explicate more fully how this model-building process is conducted and illustrate some of the preliminary results.

Tasks and Activities in Classrooms

The information-processing demands that classrooms make on students are embedded in the events that occur in these settings. It has become increasingly clear that the event structure of classroom environments can be studied from two perspectives: (1) activities; and (2) tasks. In the identification of student mediating processes, the study of tasks is more fruitful, for reasons that will be given shortly.

The concept of activities, or what Gump (1967, 1969) has called "segments," is used to designate the bounded units of

teacher and student behavior that recur in classrooms, e.g., seatwork, spelling test, small-group discussion, lecture, recitation, reading. These segments define, in other words, what teachers and students do in classrooms. There are, of course, internal structural properties of segments and these intra-segment structures influence behavior (Bossert, 1977; Gump, 1969; Kounin, 1977). That is, systematic differences in teacher and student behavior are associated with different activities. For example, activities that involve sharing of information or materials among students obviously result in different patterns of interaction and disruption from those in which students work independently. In addition, there is an inter-segment structure that defines the routines of a given classroom (see Smith & Geoffrey, 1968), e.g., spelling tests are on Thursdays after lunch, math always follows language, and so on. At a more macro-level, there are presumably different activity structures characteristic of "open" and "conventional" classroom organizations. Finally, Gump (1969) has called particular attention to the transitions between activities as critical points in the management of classrooms.

Activity segments in classrooms are inherently fascinating to study and appear to have consequences for incidental outcomes of schooling such as interpersonal affiliation and moral socialization (see Bossert, 1978; Westbury, 1978). The

concept of activity would seem, however, to have limited utility in accounting for the precise nature of academic achievement and the ways in which students process information in classrooms. The concept of task, on the other hand, has been more useful in the analysis of student mediating responses.

As defined in the present project, a task consists of (a) a goal and (b) a set of operations necessary to reach that goal. A task, in other words, designates that structural unit of the environment that has consequences for the individual. For academic tasks, the goal is defined by the performance-grade exchange in a particular classroom (see Becker, Geer, & Hughes, 1968). The situationally-defined objective, in other words, is to acquire those performance capabilities that have the greatest likelihood of receiving a positive evaluation by the teacher. The degree of success--that is, a favorable performance-grade exchange--for a student interested in academic tasks depends upon his or her interpretation of the performance capabilities required and on the way information is processed in preparation for the occasion in which performance assessment is made. (For a more detailed discussion of classroom tasks, see Doyle, 1977).

(There are, of course, nonacademic tasks in classrooms (e.g., impressing the girls, irritating the teacher, etc.) and not all students choose to participate in academic tasks.

Although important for understanding classrooms, non-academic tasks are beyond the scope of the present discussion.)

A brief illustration might help to clarify the concept of academic tasks. If, for example, students in a particular classroom are required to recognize the gist of information (stories, essays, etc.) presented during instruction, then it is possible to meet this requirement by processing the information for general meaning. This processing of information for meaning or comprehension involves a step called "semantic integration" in which the details of the text as well as inferences possible from the text are subsumed under a general semantic framework or schema (see Bransford, Mc-Carrell, Franks, & Nitsch, 1977; A. L. Brown, 1975; Paris, 1975; Spiro, 1977). If, on the other hand, accomplishing academic tasks in a particular classroom requires verbatim reproduction of information presented during instruction, then the information must be processed in a way that retains the distinctive, episodic character of the original text. Students must, in other words, resist semantic integration to avoid intrusion errors resulting from inferences that were possible from the text but were not actually present. This argument suggests that under some task requirements, processing information for comprehension will interfere with task accomplishment. At least it is important for students

to know whether they are being required to learn a generator set (Shaw & Wilson, 1976) from which answers can be derived at a later occasion or to memorize specific answers that must be reproduced when requested.

Much of the information available from classroom observations is concerned with activities rather than academic task structures. This situation is reasonably consistent with the traditional emphasis on teachers in classroom research. Teachers are preoccupied with activities in classrooms, and teacher educators are preoccupied with preparing candidates to perform these activities. In several respects, the task of the teacher is to implement activities in classrooms. If one is interested in teachers, then understandably one is interested in activities. An analysis of student mediating responses, however, requires a different view of events in classrooms. For students, the demands of the classroom environment operate in large measure through the academic tasks they encounter in this setting. To the extent that tasks operate independently of activities--a point to be discussed more fully later--then there is little reason to expect that the study of activities will give reliable information about how teaching effects occur.

Tasks and Outcomes

The study of academic task structures gives some insight into what students learn from classrooms. At a basic level,

exposure to content obviously influences the degree to which a student is familiar with a particular element of subject matter. Thus, Walker and Schaffarzick (1974) argue that inclusion and emphasis account for different outcomes among alternative curricula within the same discipline. But at a more refined level, how students process subject matter would appear to be influenced by the structure of academic tasks within a curriculum. For example, studies of cognitive preference--a measure of student attitudes toward ways of processing information--suggest that this outcome is systematically related to the information-processing tasks characteristic of a particular curriculum (see Tamir, 1975; for a review of measurement problems in this area, see S. Brown, 1975). In a more direct measure of information-processing capabilities, Greeno and Mayer (Greeno, 1972; Mayer, 1975, 1977; Mayer & Greeno, 1972) found that different cognitive structures were established by instructional methods that required different operations with the same content. In the language of the present discussion, the demands engendered by a particular set of academic tasks influence what the student is capable of doing with subject matter.

A very clear picture of the effect of task structures on outcomes is contained in Barr's (1975) study of reading strategies used by first graders. To study reading strategies, Barr examined the substitution errors pupils made when

encountering unfamiliar words in text. Pupils taught by the sight-word method substituted words from the sample of reading words contained in the instructional materials, made few non-word responses, and showed little letter-sound correspondence in attempts to identify unfamiliar words. Pupils taught by a phonics method made more non-word or partial-word responses, showed high letter-sound correspondence in making substitutions, and substituted words not contained in the instructional materials. These results would seem to be strong evidence that the way students process information is consistent with the performance-grade exchange defined by a particular instructional method. As further support, Barr also found that students who entered instruction with a strategy inconsistent with the instructional emphasis tended to modify their strategy to match that required by the method with which they were taught. Students learned, in other words, to process information in a way that generated responses consistent with the demands of the classroom tasks they experienced. Finally, Barr found that eclectic methods (combinations of sight-word and phonics) did not result in the development of parallel word identification strategies. Rather, pupils adopted a strategy consistent with the initial instructional emphasis. This finding suggests that student formulate information-processing strategies early and these strategies persist, at least in a setting that tolerates multiple forms of responses

in the performance-grade exchange. Additional research on the persistence and change of information-processing strategies and the conditions which evoke these changes would give important insights into how task structures operate.

There is also evidence that classrooms affect outcomes in subtle ways that are almost independent of instructional method. There are effects, in other words, associated with accomplishing academic tasks under classroom conditions. The argument goes as follows. Greeno (1976), using a logical task analysis, has mapped alternative solution strategies for problems involving fractions. Such problems can be represented in set-theoretic terms, geometric or spatial terms, or purely numerical terms. Each representation produces the same answer (i.e., is reliable), but representations differ in terms of the number of steps and the type of cognitive activity required to generate a solution. The numerical representation of fraction problems, for example, can be reduced to a series of computational steps that can be completed with little understanding of the nature of fractions. Different problem representations can be studied in terms of their instructional efficiency (which representation can be learned faster), their application efficiency (which representation can be more readily applied to "real world" problems), their efficiency for further learning (which representation makes it easier to learn other concepts

related to fractions), and their production efficiency (which representation generates answers faster).

For present purposes, these cognitive representations of solution strategies become especially significant in interpreting research on how students solve arithematic problems. In studies of the solution strategies pupils actually used, Resnick and her associates (Resnick, 1976; Groen & Resnick, 1977) found that pupils transformed instructional routines which were easy to articulate, represented the structure of the subject matter, but were cumbersome for generating answers, into production routines which were difficult to articulate but more efficient in generating solutions. For example, after completing several problem sets, students learned to add smaller numbers to larger numbers even though they had not been taught to follow this procedure (and in all probability did not know this algorithm prior to instruction in addition). The solution strategy was devised, in other words, from direct and repeated experience with the content. In addition, the solution strategy students devised was consistent with demand for high production efficiency, a demand engendered by the requirement that students complete a relatively large number of practice problems within a reasonably restricted time period.

Resnick's findings suggest that in accomplishing classroom tasks students are inclined to select from among Greeno's

problem representations those which are reliable and high in production efficiency. Other representations which may be more useful for understanding or learning more about the content are likely to be abandoned if they lack production efficiency. Indeed, problem representations which are cumberson for generating answers may well increase the likelihood of errors. Thus, cumbersome solution strategies might increase the probability of an unfavorable performance-grade exchange and hinder the accomplishment of classroom tasks.

One final example illustrates even more dramatically the ways in which students transform instructional representations of subject matter into solution strategies that are reliable but hardly efficient on any criterion. In a series of careful and intensive interviews with students, Erlwanger (1975) discovered students who were successful in accomplishing classroom tasks but who had fundamentally erroneous conceptions of mathematics. The students had, in other words, devised ways of getting correct answers that worked only for a very limited range of problems, violated basic assumptions in mathematics, and reflected little understanding of mathematical principles. An illustration of this kind of strategy--Erlwanger's examples are considerably more bizarre--involves the use of "counting points" (a "4" has four counting points at the ends of the lines) on numbers to add. The system is highly reliable but hardly efficient or useful for learning how to add.

In summary, analysis of the relationship between classroom tasks and outcomes suggests that what students know about academic content is embedded in the tasks they encounter in classroom settings (Bossert, 1978, makes a similar point with reference to classroom activities). If we are to understand the nature of academic achievement, then it is necessary to learn more about classroom task structures. It is even likely that some outcomes, especially if defined in terms of cognitive operations rather than simply in terms of the answers students produce, are very difficult to achieve under conditions in which classroom tasks are accomplished.

Tasks and Cue Resources

In addition to the matter of outcomes, the study of classroom tasks provides insight into how students utilize cue resources available in the classroom environment. The details of this analysis have been presented elsewhere (Doyle, 1977) and therefore will only be summarized here. The basic argument is that knowledge of the task structure serves as a guide to navigate a classroom environment, to select and interpret the various information sources operating at any one time in a setting. Stimuli that provide students with information about the nature of the performance-grade exchange or the operations that need to be used to generate appropriate performances will be of particular importance for accomplishing classroom tasks.

If activities define what teachers and students do in classrooms, task structure defines the situational meaning of these segments for students interested in a favorable exchange of performance for grades. In this sense, the structure of tasks provides a general semantic network or schema (see Anderson, 1977; Schank & Ableson, 1977) for the academic system of a classroom. It is, in other words, the overall framework, or scaffolding, for processing information in classrooms and specifies, in academic terms at least, the functional properties (see Hymes, 1977) of classroom activities. A study of activity segments might report, for instance, that a student spent x amount of time reading a book. An analysis of the academic task structure operating in that classroom would enable predictions about what the student learned as a result of reading.

The effects of task structures on how students utilize information resources can be illustrated with some research data from the field of prose learning. Meyer (1975, 1977), for instance, found in laboratory experiments that the content structure of a prose passage influenced what was remembered from the passage. Concepts high in the content structure were recalled better than concepts low in the hierarchy. Under instructions to learn the passage, readers used the content structure as a guide to extract information from the text. Pichert and Anderson (1976) found, however, that

more explicit task instructions counteracted text structure effects: subjects remembered items specified in the task instructions better than items defined by the content hierarchy of the text. Such findings suggest that when written materials are embedded in classrooms, the classroom task structure takes precedence over the text structure in determining what information is processed by students. This might explain how children can appear to "learn" (i.e., accomplish classroom tasks) from materials that because of logical operations (MacGinitie, 1976) or syntax (Gammon, 1973) are beyond their capabilities.

Some limited evidence for the effects of classroom tasks on the processing of information in classrooms is contained in a recent report by Kintsch and Bates (1977). They studied the effect of the content structure of a classroom lecture (college-level psychology) on short- and long-term memory for the information contained in the lecture. The patterns of student recall did not conform to predictions based on Meyer's (1975) findings: students remembered more concepts than simply those high in the content structure of the lecture. Apparently other structural guides were being utilized by students to select and encode information from the lecture. Although Kintsch and Bates did not explain their findings in this way, it would seem that knowledge of the classroom task structure would have given some clue concerning the strategies students used to process the lecture.

The analysis of cue utilization suggests that the concept of task structure is a useful foundation on which to build a treatment theory for classroom research. It is, in other words, a way to account for how classroom effects occur. According to this theory, what a student learns depends on the operations he or she performs in accomplishing tasks defined by the academic system of a classroom. Utilization of information resources would seem to depend, in turn, on a student's perception of the way in which the resource is related to task accomplishment. Teacher praise, for example, will affect learning to the extent that it communicates information useful in accomplishing academic tasks in a particular setting.

Tasks and Student Participation

Implicit in the foregoing discussion is the premise that tasks exist independently of activities in classrooms. A teacher can, for instance, require verbatim reproduction of previously encountered solutions and yet fill classroom time with a wide variety of activities. Similarly, the same task structure can operate in both "open" and "conventional" classroom organizations. Task structures, in other words, can function across individual lessons and are often constant for an entire semester. The previous analysis suggests that in comparing settings with different activity segments but equivalent task structures, it is reasonable to expect little difference in what is learned.

From a different perspective, not all activities in a classroom are necessarily tasks. A task, in the academic sense as it is being used here, exists whenever a performance-grade exchange is in operation. The task structure is therefore closely connected with the evaluation system in a classroom (see Jackson, 1968, on prevalence of evaluation in classroom environments). Teachers are, however, typically vague on the question of whether an activity is a task. When asked, for instance, if the material being discussed is going to be on the test, most experienced teachers are ambiguous: "It would be well if you knew it." This ambiguity often retains the guise of a classroom task for an activity that is not part of the performance-grade exchange. Teachers also frequently invoke task-related consequences (e.g., threats of lower grades or additional tests) to secure participation in activities.

This pattern of teacher behavior, together with the previous analysis of how students utilize cues in classrooms, suggest that student participation in classroom activities is connected to the task structure. On the surface at least, the study of classroom tasks would seem to have implications for interpreting data on student attention or "time on task."

But direct academic consequences are not the only ones that operate in classrooms. Failure to cooperate with procedures (i.e., to attend to tasks) can have consequences

independent of the performance-grade exchange. In addition, since grades are partly subjective, consistent lack of cooperation can affect the value of the exchange by affecting teacher sentiments toward a student. It is possible, therefore, to observe high levels of participation in activities that are not part of the task system. Presumably skillful students can use their knowledge of task structures to segment these activities from those that are part of the performance-grade exchange in order to avoid possible interference effects.

Actual level of participation in activities would seem to be a function of both the task structure and the disciplinary system in a classroom. This proposition suggests that the interpretation of measures of student participation needs to be done with knowledge of the classroom task structure. Since such measures are confounded, however, the study of activities alone can be a misleading indicator of how learning effects occur in classrooms.

Consequences of Task Management Practices

To this point in the discussion, the focus has been on <u>what</u> is learned in classrooms. The model of student mediating responses being developed here also has implications for questions of how much is learned, how well it is learned, and who learns in classrooms. These latter questions are associated with issues of (a) the types of tasks that exist in a classroom; and (b) the way these tasks are

administered. A consideration of these issues of task management brings the analysis close to the study of classroom conditions.

The overall task structure of a classroom is defined by the total configuration of academic tasks that operate in that setting. Classrooms can obviously differ in terms of the number of academic tasks, that number being determined by the occasions on which a performance-grade exchange takes place. Within a given content area (math, language, etc.), the type of tasks can also differ, and there is no necessary internal consistency among tasks or over time. Teachers can, for instance, ask higher-order questions during class discussions and test for recall of the answers to such questions during examinations. Certainly during a school day students encounter a reasonably wide array of different types of academic tasks.

Different types of classroom tasks place different demands on students. As suggested earlier in this paper, "understanding" tasks require different information-processing strategies than "memory" tasks. In an understanding task, the emphasis is on having students learn a set of generative principles or operations that are then applied to unencountered instances in order to derive answers. The task, in other words, is to generate rather than reproduce an answer, and a particular answer cannot

be predicted completely in advance. This mode of thinking about content seems to underlie many "inquiry" or "discovery" approaches to curriculum. Memory tasks, on the other hand, require reproduction of answers that have already been encountered and such tasks vary primarily in terms of the amount of information that must be processed. (The distinction between understanding and memory task types is based in part on Anderson, 1972). The types of tasks would clearly seem to interact with student ability. Some tasks may simply be inherently more difficult to accomplish or more difficult for particular students. It is likely, for instance, that understanding tasks are more demanding for many students than memory tasks. The type of tasks operative in a given classroom can therefore affect the probability of task accomplishment for individual students and, in turn, influence who learns in that setting.

The demand character of a classroom task is also affected by the total range of different types of tasks that are used. Classrooms that combine many different types of tasks obviously require a greater range of information-processing capabilities and alertness by students to changes in tasks. This factor should also influence the probability of task accomplishment for individual students.

In addition to the effects of task types, there is evidence that the way tasks are administered and other more

general conditions of classrooms influence outcomes. Pace, for example, can affect exposure to content and therefore influence how much is learned in a particular classroom. In addition, pace is positively associated with variance in outcomes: a more rapid instructional pace tends to increase the differences in achievement between high and low ability students (on pace effects, see Arlin & Westbury, 1976; Atkinson, 1976; Barr, 1974). Pace can affect, therefore, who learns in a classroom.

In addition to pace, outcomes would seem to be influenced by the number and the clarity of cue resources available in a particular instructional environment. Classroom tasks are typically accomplished in an environment of considerable complexity and unpredictability. Many events take place in these settings, many of these events take place at the same time, and the pattern of events is not always regular. This way of typifying the classroom environment suggests that a successful exchange of performance for grades requires considerable student skill in utilizing environmental cues. A successful student must be able to use available information to identify acceptable performances, adjust the definition of acceptable performances to account for variations over time, and compensate for the lack of instructional resources within the classroom setting itself (on these utilization skills, see Doyle, 1977). In order to learn from classrooms,

a student must not only be able to process the subject matter but also be able to process the classroom environment, that is, he or she must be skilled in exercising differential attentiveness to classroom stimuli in order to locate cues that have salience for defining the academic task structure in a given setting. Although empirical data are needed, variations in these utilization skills would seem to be associated with how well students learn in classrooms.

In summary, the type of tasks implemented and the way in which they are implemented would seem to affect classroom outcomes. The task structure defines the functional aspects of a classroom setting and gives meaning to environmental variables. In this way it affects what is learned from classrooms and how students process available cue resources. Tasks themselves and the settings in which they are enacted vary, however, in characteristics that influence the probability and efficiency of task accomplishment. These factors influence who learns and how much is learned in classrooms. The analysis of both task structure and management dimensions gives some insight into the demand characteristics of classrooms and the way these settings affect outcomes.

A brief comment on the effects of highly structured teaching systems such as direct instruction (Rosenshine, 1976) and mastery learning (Bloom, 1976) would seem to be in order. Available, although certainly not conclusive,

evidence suggests that use of such systems is associated with higher mean achievement scores and, in the case of mastery learning, less variance in outcomes. In task structure terms, the probability and efficiency of task accomplishment is high, factors which influence who and how much is learned. The criterion for judging effectiveness would seem, however, to be relatively generous: Did instructional effects occur? More stringent criteria regarding the durability and transferability of effects have seldom been applied to such findings. In a series of studies on training young children in the use of memory strategies, Brown and her associates (A. L. Brown & Campione, 1977; A. L. Brown, Campione, & Murphy, 1977) found that immediate effects under heavily prompted conditions were relatively easy to obtain. That is, training in specific memory strategies used spontaneously by successful learners improved the performance of less successful learners. The use of these strategies was not, however, very durable and did not transfer. Considerably more training was required to achieve a reasonable degree of durability, but transfer did not improve. In fact, when large amounts of training were given to increase durability, the strategies became "welded" to the training environment and less transfer seemed possible. Performance, in other words, became highly dependent upon prompts available in

a specific training setting. This analysis would also seem applicable to Rohwer's (1973) findings on the effects of elaboration on learning noun-pair lists. He reports that if prompt conditions are sufficiently explicit, the performance of very young learners (three to five years old) can match that of older learners (fifteen to eighteen years old). Such performance levels for the younger subjects would seem, however, to be highly dependent on the heavy prompt conditions that are necessary to activate elaboration. Although such results are dramatic, they give little insight into what is learned by the younger students.

What seems to be operating in highly structured teaching systems is what might be called a "heart-pacer effect." If the instructional system does enough information processing for the learner, then he or she will appear to accomplish the learning task embedded in the system and "effects" will be obtained. If the very agressive external information-processing support is removed, however, performance levels decline. The student has not learned, in other words, how to accomplish academic tasks independently. This analysis suggests that attention needs to be given not simply to "effects" but also to the nature of these effects and how they relate to the student's continuing ability to accomplish academic tasks in classroom settings.

Learning from Classrooms as Problem-Solving

One way to summarize the model of student mediation that is emerging from this project is to view learning from classrooms as a mode of problems-solving (see Simon & Hayes, 1976). The first task in problem solving is to define, using various sources of information, the problem structure and the appropriate operations that can be performed on elements in that structure to generate acceptable solutions. In the language of the present discussion, the problem "space" for academic learning is defined by the classroom task structure. Once a conception of the task structure has been formulated, a student can use it as a guide to select and interpret cues, predict likely problem states, and evaluate potential solutions. The task structure becomes, in other words, a map with which to navigate the academic terrain of the classroom. A student who knows this map well can accomplish classroom tasks with efficiency and with a high probability of success. Such a student can, for instance, recognize that certain types of information or operations are unlikely to be included in the performance-grade exchange in a particular classroom and therefore not have to spend time processing such information. Such a student can also learn that certain cue resources (e.g., teacher feedback to certain students or answers given by some students to teacher questions) are not reliable indicators of task

demands and can therefore be safely ignored. Knowledge of the classroom task structure, in other words, enables a student to understand the academic system and therefore predict the likelihood of certain events in that setting (see Schank & Abelson, 1977). Failure to learn the task structure of a classroom, on the other hand, can reduce both the probability and the efficiency of accomplishing academic tasks and thus influence what and how much is learned in a particular setting.

From the viewpoint of task management, some classrooms are well-formed and some are ill-formed problems. In contrast to the former, ill-formed problems rely for their conceptualization and solution on more extensive "knowledge of the world" that the person brings to the situation (see Simon & Hayes, 1976). If the cue system in a classroom is highly unreliable or difficult to identify, then task accomplishment becomes more difficult and depends to a greater extent on the student abilities. In this light, direct instruction (Rosenshine, 1976) might be viewed as a "well-formed problem" that depends less on the entering capabilities of the student to achieve its effects.

From a slightly different perspective, the academic task structure would also seem to serve as a mnemonic device to facilitate memory for information previously encountered in classrooms. It would seem to provide, in other words,

a semantic framework for coding, storing, and retrieving information that is made available to students through the various cue resources in a particular classroom setting (on this point, see Kintsch, 1975; Thorndyke, 1977). Such a view suggests that knowledge of subject matter gained in classroom settings is episodic (Tulving, 1972), i.e., embedded in the concrete features of task structures and their management. Alternatively, the approach implies that classroom-based knowledge of subject matter is perhaps integrated semantically in terms of task structures defined by the classroom setting rather than by the content itself. These propositions are consistent with findings (Duke, Muzio, & Wagner, 1978) that students had difficulty recalling what they had learned in a course when asked by an outside interviewer. The interview situation may have simply lacked the necessary retrieval cues that were contained within the task system of the classroom in which the knowledge of subject matter was obtained. This approach certainly has consequences for understanding the nature of what is learned in classrooms.

The analysis of classroom learning in terms of problem-solving and memory underscores the central role of the student's knowledge of classrooms. Research on instruction has traditionally emphasized tasks defined by subject matter (e.g., Glaser, 1976). The present model gives priority to tasks

defined by the classroom task structure and carries the implication that subject matter is encountered and contextualized through such structures. This point may have important implications for interventions to help students learn from classrooms. It suggest in particular that training at the level of understanding classroom task structures rather than at the level of specific processing strategies might well be more successful (Cf. A. L. Brown & Campione, 1977).

Implications

There are certainly other mediating strategies students use to either control or circumvent task demands in classrooms. These mediating strategies have been discussed at length elsewhere and therefore will not be reviewed here. The present discussion has, rather, concentrated on the mediating responses most directly related to academic achievement, a traditional area of concern in teaching effectiveness research. Even then, the coverage of relevant research has only been partial. Moreover, the line of evidence has been precariously thin at several points. Considerably more research with a specific focus on classroom tasks and their implementation is certainly necessary to substantiate the various aspects of the model advanced in this paper.

Nevertheless, the model of student mediating responses emerging from this project would seem to be a useful tool for integrating and interpreting data about information processing and learning and relating these data to the special circumstances found in classrooms. The model would also seem to be useful for integrating classroom variables into a treatment theory that accounts in some ways at least for how classroom effects occur. Finally, there are some suggestions that the model is valuable as a basis for formulating questions for further research on effective teaching in classroom settings.

At several points in the discussion implications of the model were specified for interpreting such issues as measures of time on task and the effects of direct instruction. Little comment has been made, however, on the question of teacher effects. It would seem appropriate, therefore, to conclude with some attention to this question.

The analysis of classroom tasks suggests that teacher effects are largely indirect (a similar point was made by Gump, 1964). Teacher effects are mediated first through the task structures implemented in the classroom. As indicated in the analysis, the task structures teachers use in classroom affect what is learned. Second, teacher effects on who learns and how much is learned are mediated through the way in which they manage the tasks that are used in a

classroom. It is important to add that teachers are not totally independent agents in classrooms. There is a substantial body of evidence accumulating that students play an important role in determining which tasks operate in classrooms and how these tasks are managed. In addition, the classroom environment itself has an impact on task selection and implementation. More knowledge is needed concerning how classrooms work--about the structure and processes of classroom life--to understand why various patterns occur in these settings.

If this analysis is accurate, then a direct study of teacher behavior would seem to have limited utility for generating information about effective teaching unless that behavior can be linked with other dimensions of the classroom environment. It is clear, in other words, that the study of teaching involves considerably more than the study of teachers.

In summary, the study of student mediating responses is raising a number of exciting new issues in classroom research. In addition, this study is beginning to provide a means for answering a basic question in defining effective teaching: Why should we expect a particular classroom variable to have any effect on student learning outcomes?

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